FLEXIBLE DEVICE DEFORMATION MEASUREMENT

TECHNICAL FIELD

[0001] The present invention generally relates to flexible electronic devices and especially but not exclusively to measuring deformation of flexible electronic devices.

BACKGROUND ART

[0002] Electronic devices can be made of elastic, flexible or bendable material thereby enabling production of flexible electronic devices. Flexible electronic devices can be made of rigid materials, too. For example combining many rigid parts with joints like in a caterpillar chain results in a flexible structure that can be used to produce flexible electronic devices. Flexible electronic devices may comprise functionality that is controlled by deforming the device.

SUMMARY

[0003] According to a first example aspect of the invention there is provided a method comprising

- **[0004]** monitoring deformation of a flexible electronic apparatus; wherein said monitoring of deformation comprises
- **[0005]** detecting changes in space within the apparatus between at least two measurement points; and
- **[0006]** determining degree of deformation of the apparatus based on the detected changes in the space within the apparatus between the at least two measurement points.

[0007] According to a second example aspect of the invention there is provided an apparatus an apparatus structure configured to allow deformation of the apparatus;

- **[0008]** detection equipment configured to detect changes in space within the apparatus between at least two measurement points; and
- **[0009]** a processing unit configured to determine degree of deformation of the apparatus based on the detected changes in the space within the apparatus between the at least two measurement points.

[0010] According to a third example aspect of the invention there is provided a computer program product comprising computer code for causing determining degree of deformation of a flexible electronic apparatus based on changes detected in space within the apparatus between at least two measurement points, when executed by an apparatus. Additionally, in further examples, the computer program product comprises computer code for causing performing the method of one or more example embodiments of the invention, when executed by an apparatus.

[0011] According to a fourth example aspect of the invention there is provided a non-transitory memory medium comprising the computer program of the third example aspect of the invention.

[0012] Different non-binding example aspects and embodiments of the present invention have been illustrated in the foregoing. The above embodiments are used merely to explain selected aspects or steps that may be utilized in implementations of the present invention. Some embodiments may be presented only with reference to certain example aspects of the invention. It should be appreciated that corresponding embodiments may apply to other example aspects as well.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The invention will be described, by way of example only, with reference to the accompanying drawings, in which:

[0014] FIG. **1***a* shows a schematic front view of an apparatus according to an example embodiment of the invention;

[0015] FIG. **1***b* shows a schematic side view of an apparatus according to an example embodiment of the invention;

[0016] FIG. **2** shows a schematic block diagram of an apparatus according to an example embodiment of the invention;

[0017] FIG. **3***a* shows a cross-sectional side view of an apparatus according to an example embodiment of the invention in an unbent position;

[0018] FIG. **3***b* shows a cross-sectional side view of an apparatus according to an example embodiment of the invention in a bent position;

[0019] FIG. **4***a* shows a cross-sectional side view of an apparatus according to an example embodiment of the invention in a slightly bent position;

[0020] FIG. **4***b* shows a cross-sectional side view of an apparatus according to an example embodiment of the invention in a strongly bent position;

[0021] FIG. **5** shows a schematic front view of an apparatus according to an example embodiment of the invention;

[0022] FIG. **6** shows a cross-sectional view across line A-A of the apparatus of FIG. **5**;

[0023] FIG. **7** shows a schematic view of a tab-and-hole structure;

[0024] FIG. **8** illustrates measurements according to an example embodiment of the invention in a tab and hole structure; and

[0025] FIG. **9** shows a flow diagram illustrating a method according to an example embodiment of the invention.

DETAILED DESCRIPTION

[0026] Some example embodiments of the present invention and potential advantages are understood by referring to FIGS. **1***a* through **9** of the drawings.

[0027] A flexible electronic device may be (temporarily) deformed into a different shape by the user of the device. A neutral position of the device is typically flat. The device can be deformed into many different shapes such as concave, convex, twisted, S- and Z-shape, J- and L-shape for example. One device may be configured to be deformed into one or more different shapes.

[0028] In an example embodiment a flexible device is configured to be controlled by deforming the device. The device can be controlled to take certain action for example by bending or twisting the device into different shapes (different shapes causing the device to perform different actions). A user may for example bend the device to zoom or twist the device to browse lists. Such functionality requires determining degree of deformation of the device so that it can be determined which action to take. For example the direction and amount of deformation of the device need to be known to enable such kinetic controlling (controlling by deforming the device) of the device.

[0029] A flexible device structure can comprise several functional layers and/or components. Such layers usually have limited ability to stretch and compress. When an object bends or twists, the portions furthest away from a neutral plane need to stretch or compress the most. It is more difficult to bend one thick object than an equally thick stack of several thin objects. Thin objects would also experience less stress